# *GOES-R High Spectral Sounder Data Compression Meeting*

May 22, 2003


**Compression Team Member:**

**NOAA – Roger Heymann; Tim Schmit; Mitch Goldberg; Walter Wolf; Lihang Zhou**

**NASA – Pen-Shu Yeh**

**Aerospace – Steve Hou**

**UW – Bormin Huang; Kevin Baggett; Allen Huang**


## Summary of Retrieval Performance with Various Compression Techniques

**Presented by Allen Huang of UW**

# Description of Datasets Used

- **AIRS Simulated Granule** 176, April 1, 2002, Provided by Walter Wolf, NOAA
  - Includes Level 1B Noisy and Noise-free Radiances and Level 2 Temperature, Water Vapor and Ozone profiles
- **AIRS Real Granule** 16, September 6, 2002
  - Includes Level 1B Noisy Radiances Only
- **GIFTS Simulated IHOP Data Cubes** – UW only for now

# AIRS Simulated Granule 176

- Produced Longwave, Midwave and Shortwave datasets
- Supplied Pen-Shu Yeh (Goddard) and Hsieh (Steve) Hou (Aero Inc) with datasets containing Noise-free & noisy radiances
- Converted 32-bit radiance values into 16-bit unsigned integers (0 to 65535)
- Filtered out the bad channels according to the channel properties file Version 5.1.2.
  - Total Channels: 1095 LW, 542 MW, 466 SW = 2103/2378
- Once datasets received from Yeh and Hou, performed retrieval using Level 2 Profiles as 'truth'

# AIRS Real Granule 016, September 6, 2002

- AIRS Focus day granule over Europe
- Separated into LW, MW, and SW, but did not filter out the bad channels according to the channel properties file
- Found additional bad channels not listed in channel props
- For each band, separated into good and bad radiances.
  - Scaled good radiances into unsigned 14-bit (0 to 16383), but stored as 16-bits as per request from Yeh and Hou.
  - Scaled bad radiances separately into 14-bits as well, but will filter out when performing retrievals.
- Delivered to Hou and Yeh, but have not received compressed results as of yet

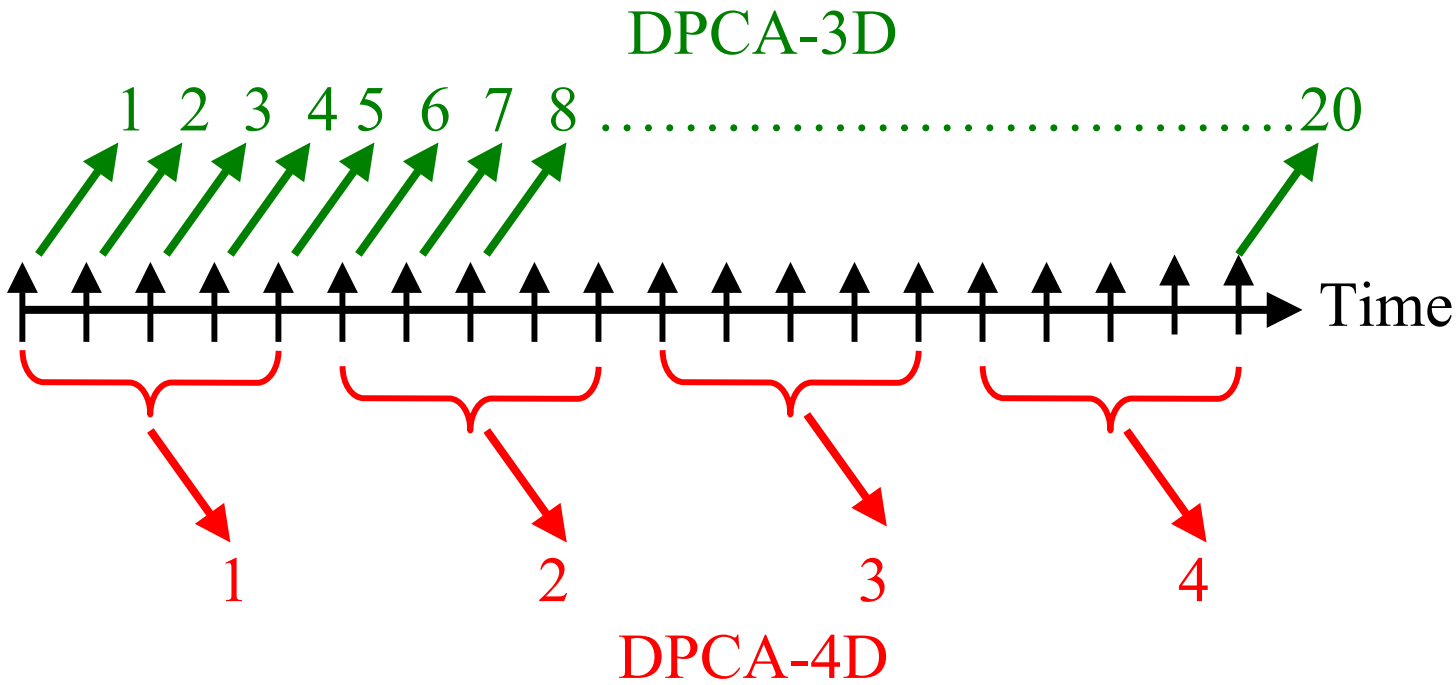
# GIFTS Simulated IHOP Data Cubes

- Perform principal component analysis on 3-D (Latitudinal, Longitudinal, Spectral) and 4-D (3-D with Temporal) 30 Data Cubes (5 time steps every half hour, 2 by 3 cubes over the IHOP domain)
- Compare Reconstructed Data for various PCs with Noisy and Noise-Free data using both approaches.
- Document the amount of CPU Time to show that the 4-data compression is much faster while producing comparable results to the 3-D data.

# Dependent Principal Component Analysis on 4-D Data (DPCA-4D)

4-D: Latitudinal, Longitudinal, Spectral & Temporal domains

3-D: Latitudinal, Longitudinal, & Spectral domains



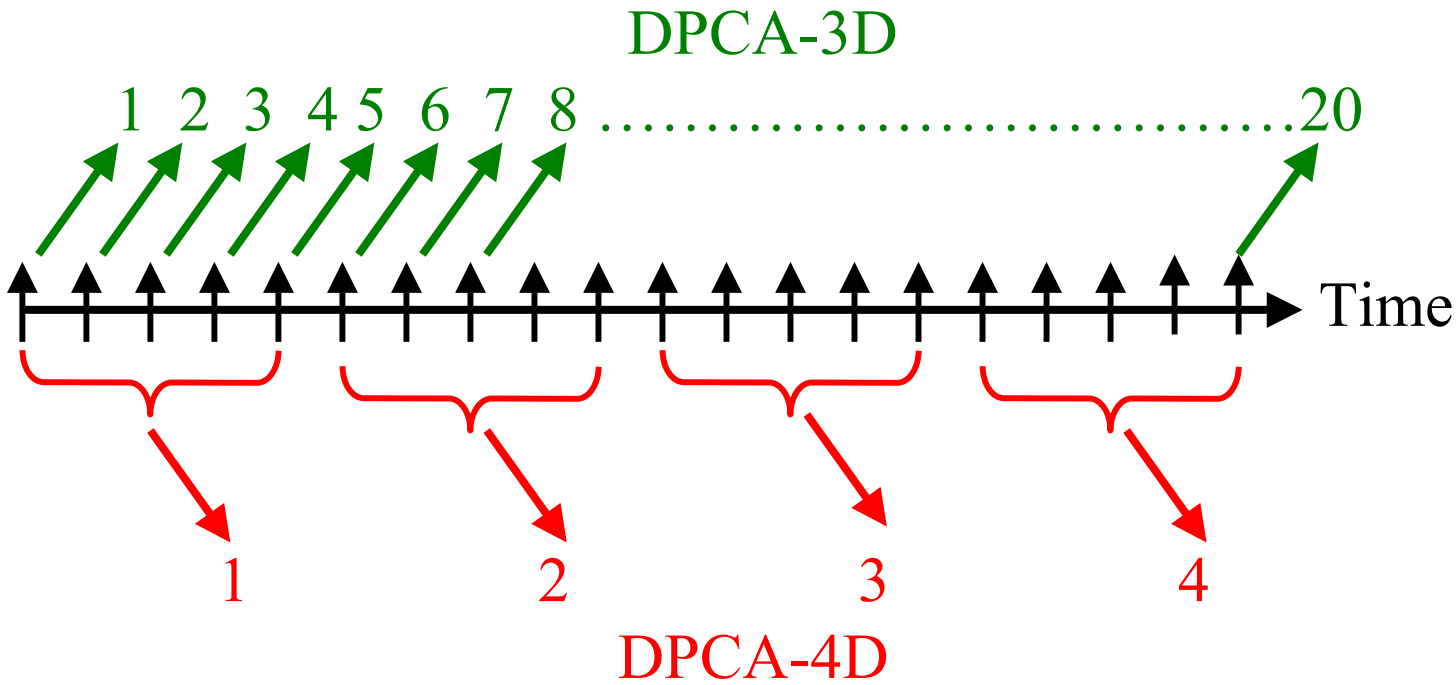

DPC on 3-D GIFTS: PC derived from radiance spectrum covariance (1728 ch. by 1728 ch.) of one cube (128 by 128 = 16384 FOVs; 11 seconds)

DPC on 4-D GIFTS: PC derived from radiance spectrum covariance (1728 ch. by 1728 ch.) of 5 cubes (128 by 128 x 5 = 81920 FOVs; 55 seconds of 2 hours 5 time steps' measurements)

# Dependent Principal Component Analysis on 4-D Data (DPCA-4D)

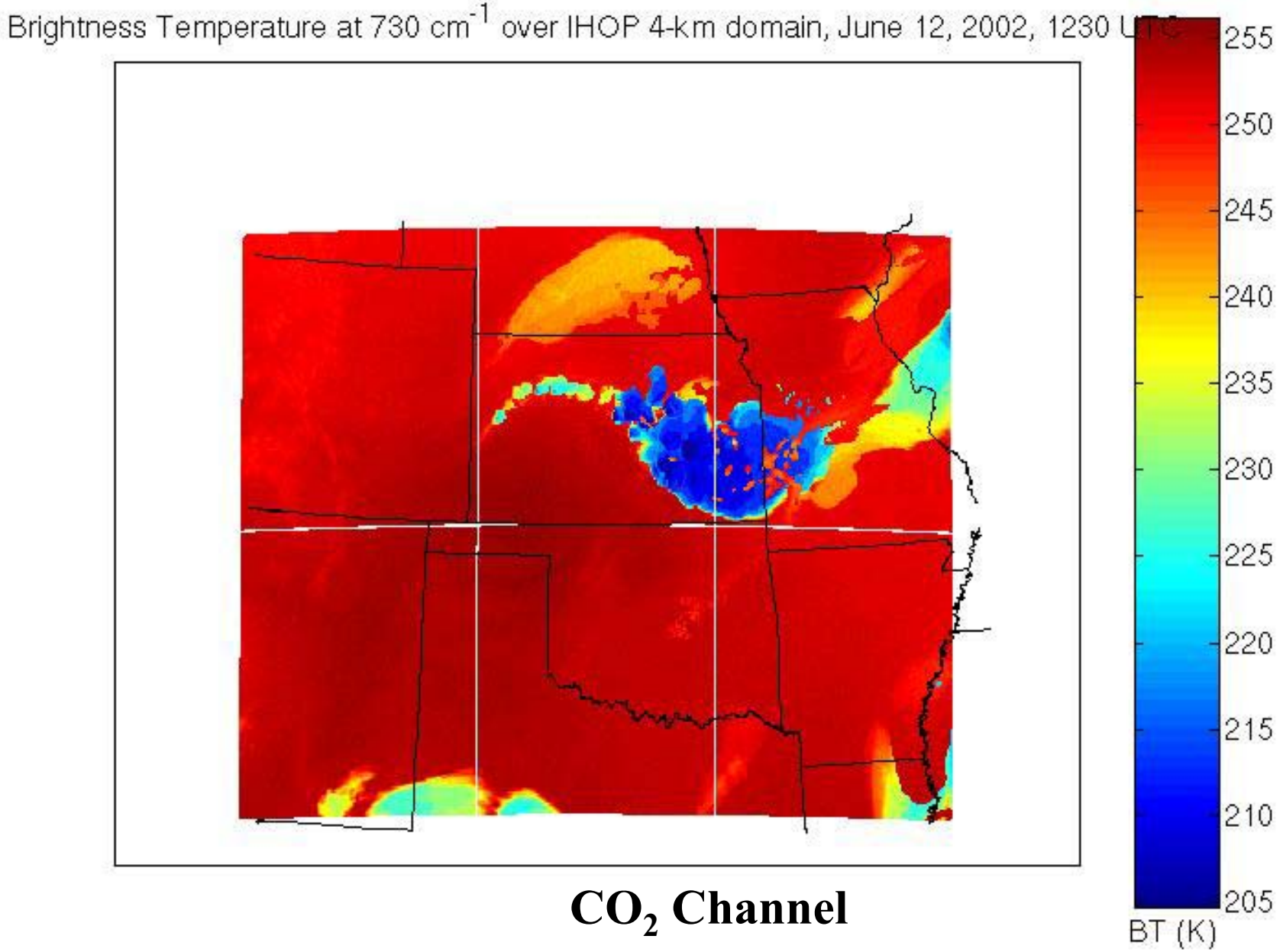
4-D: Latitudinal, Longitudinal, Spectral & Temporal domains

3-D: Latitudinal, Longitudinal, & Spectral domains

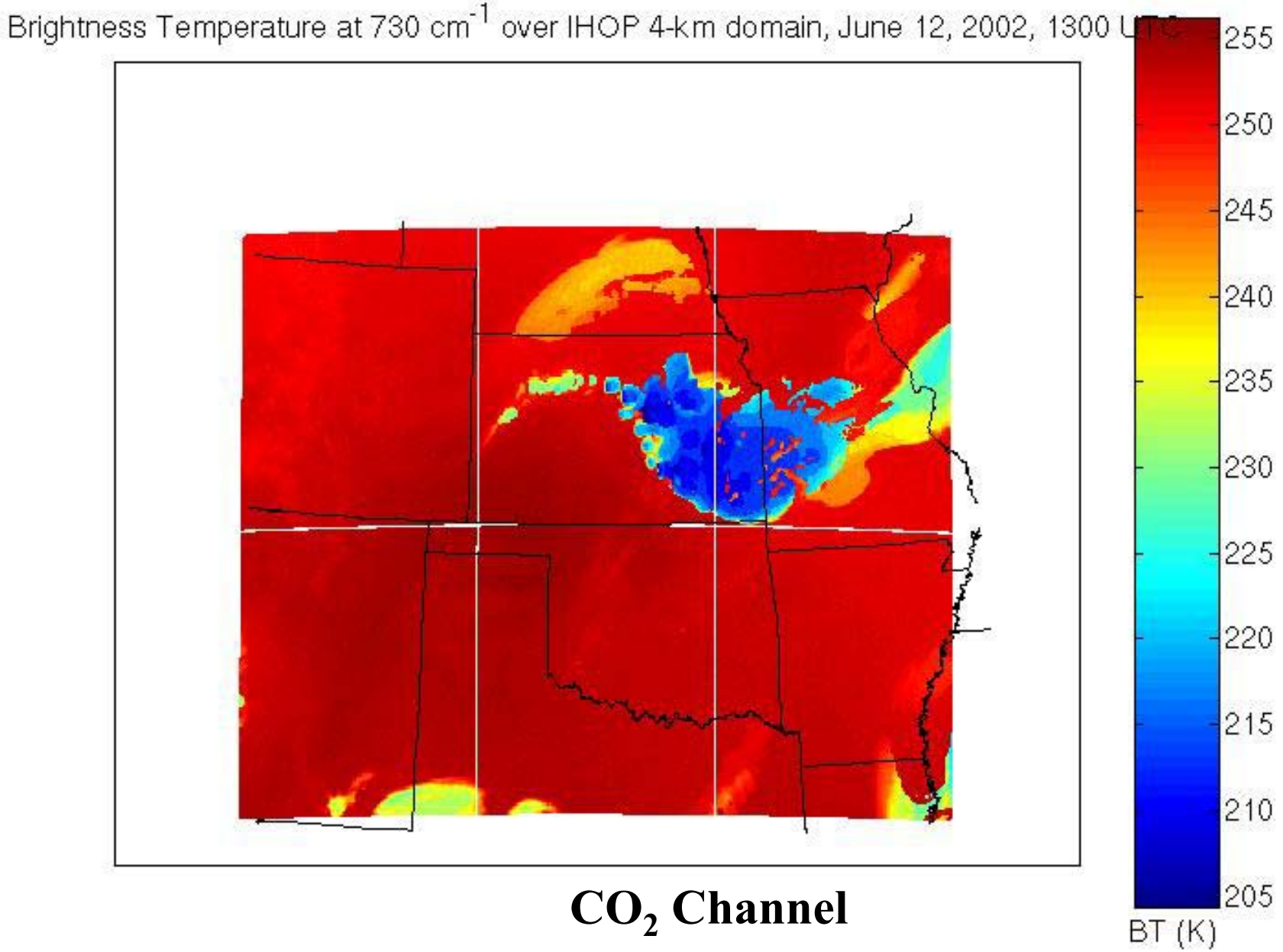



DPC on 3-D GIFTS: need to perform 20 PCA (16384 sample size); and 20 PCC; & PCNF/PCNE processing.

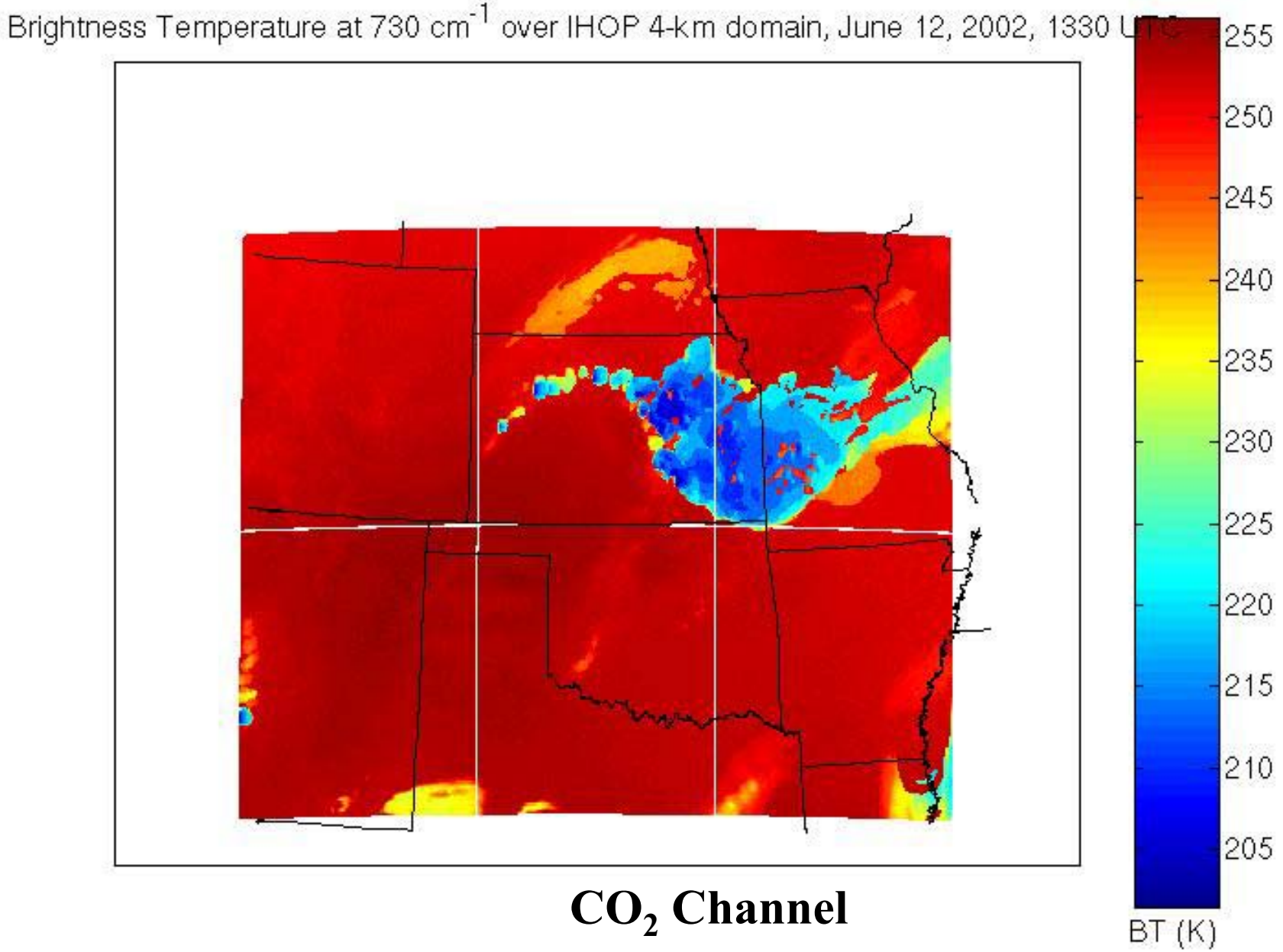
DPC on 4-D GIFTS: need to perform only 4 PCA (81920 sample size); and 20 PCC; PCNF/PCNE processing.


Brightness Temperature at 730 cm-1 over IHOP 4-km domain, June 12, 2002, 1230 UTC
255
250
245
240
235
230
225
220
215
210
205
BT (K)

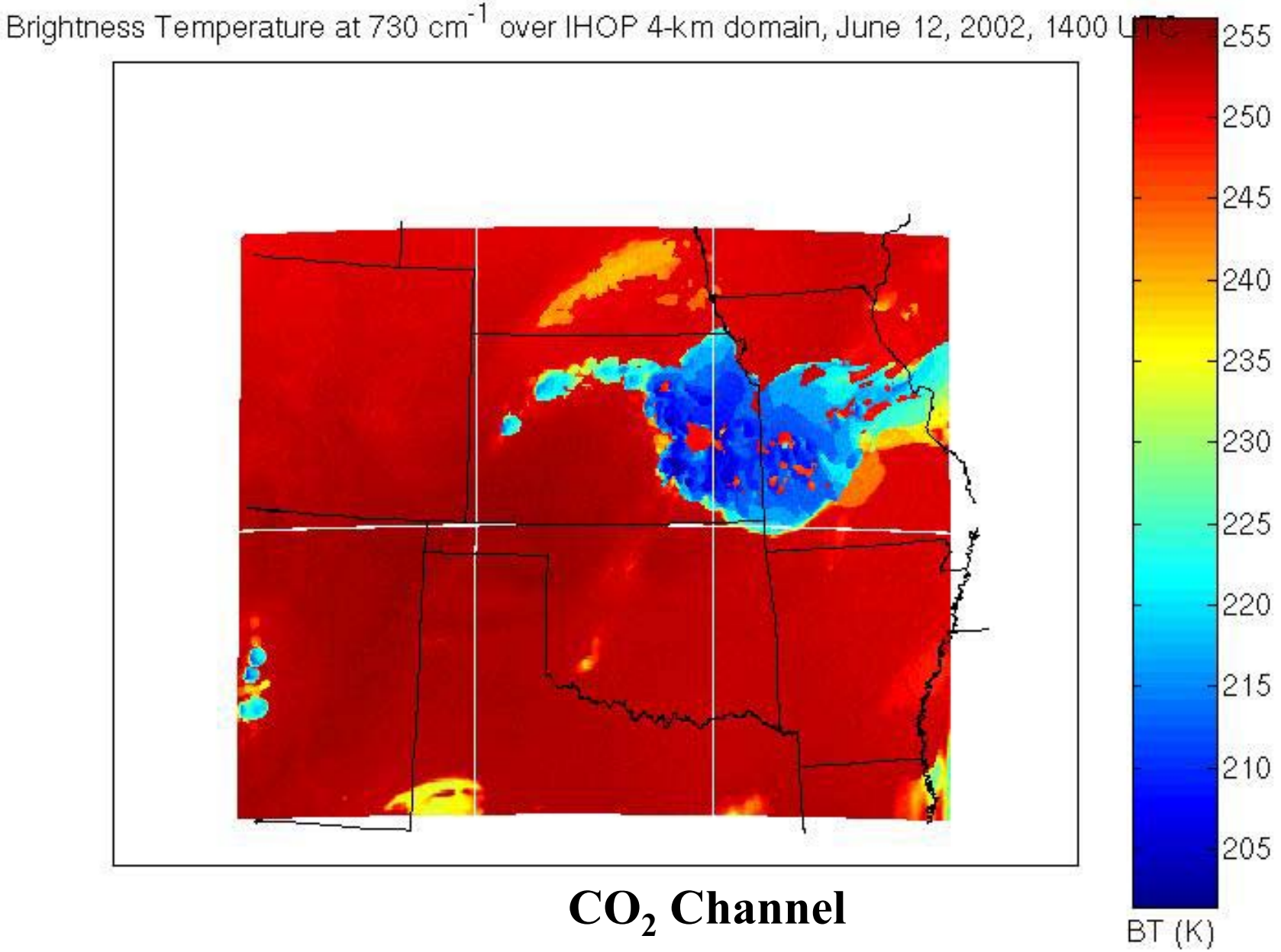
**$CO_2$ Channel**


Brightness Temperature at 730 cm-1 over IHOP 4-km domain, June 12, 2002, 1300 UTC
255
250
245
240
235
230
225
220
215
210
205
BT (K)

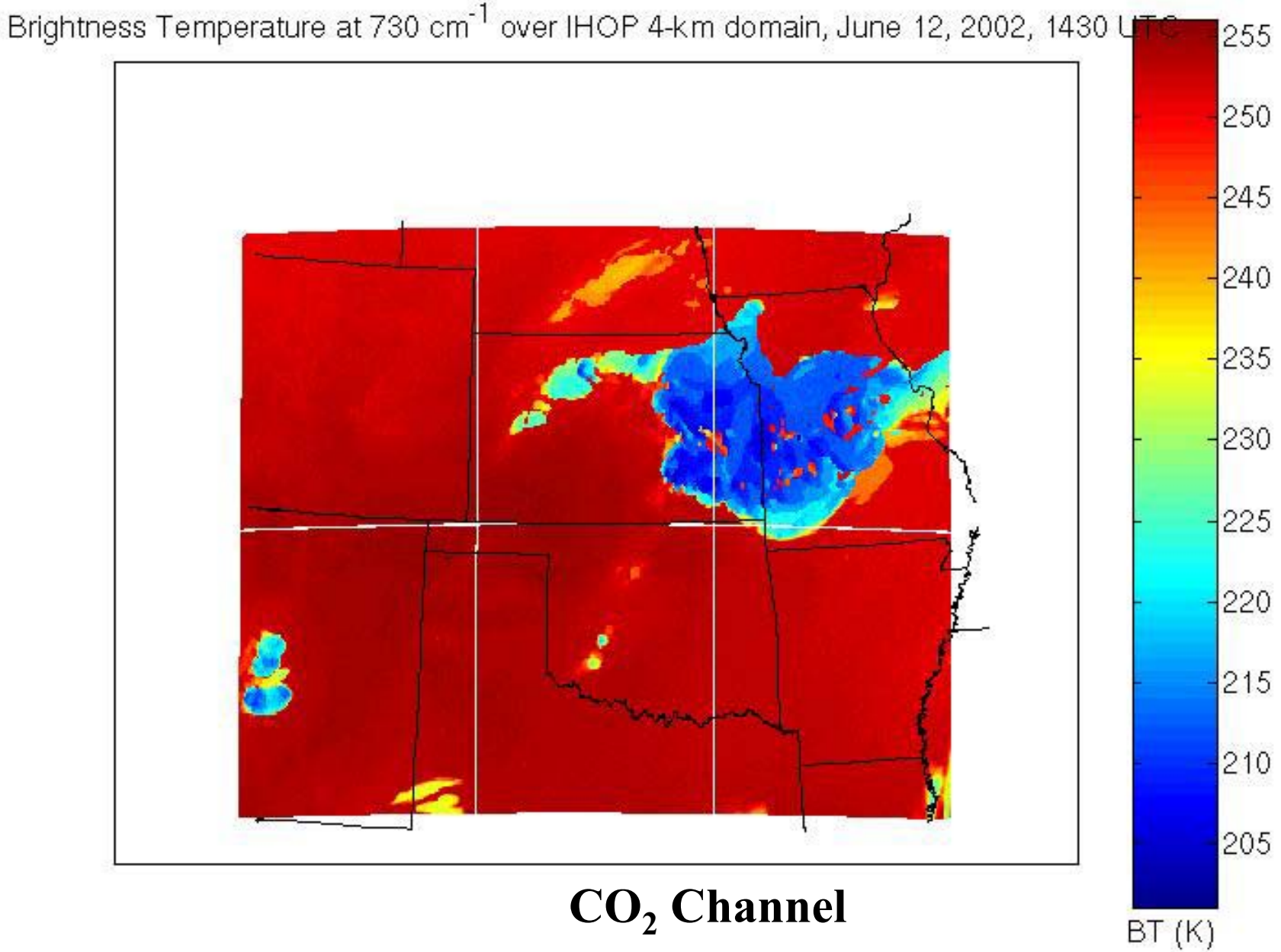
**$CO_2$ Channel**


Brightness Temperature at 730 cm-1 over IHOP 4-km domain, June 12, 2002, 1330 UTC
255
250
245
240
235
230
225
220
215
210
205
BT (K)

**$CO_2$ Channel**


Brightness Temperature at 730 cm-1 over IHOP 4-km domain, June 12, 2002, 1400 UTC
255
250
245
240
235
230
225
220
215
210
205
BT (K)

**$CO_2$ Channel**


Brightness Temperature at 730 cm-1 over IHOP 4-km domain, June 12, 2002, 1430 UTC
255
250
245
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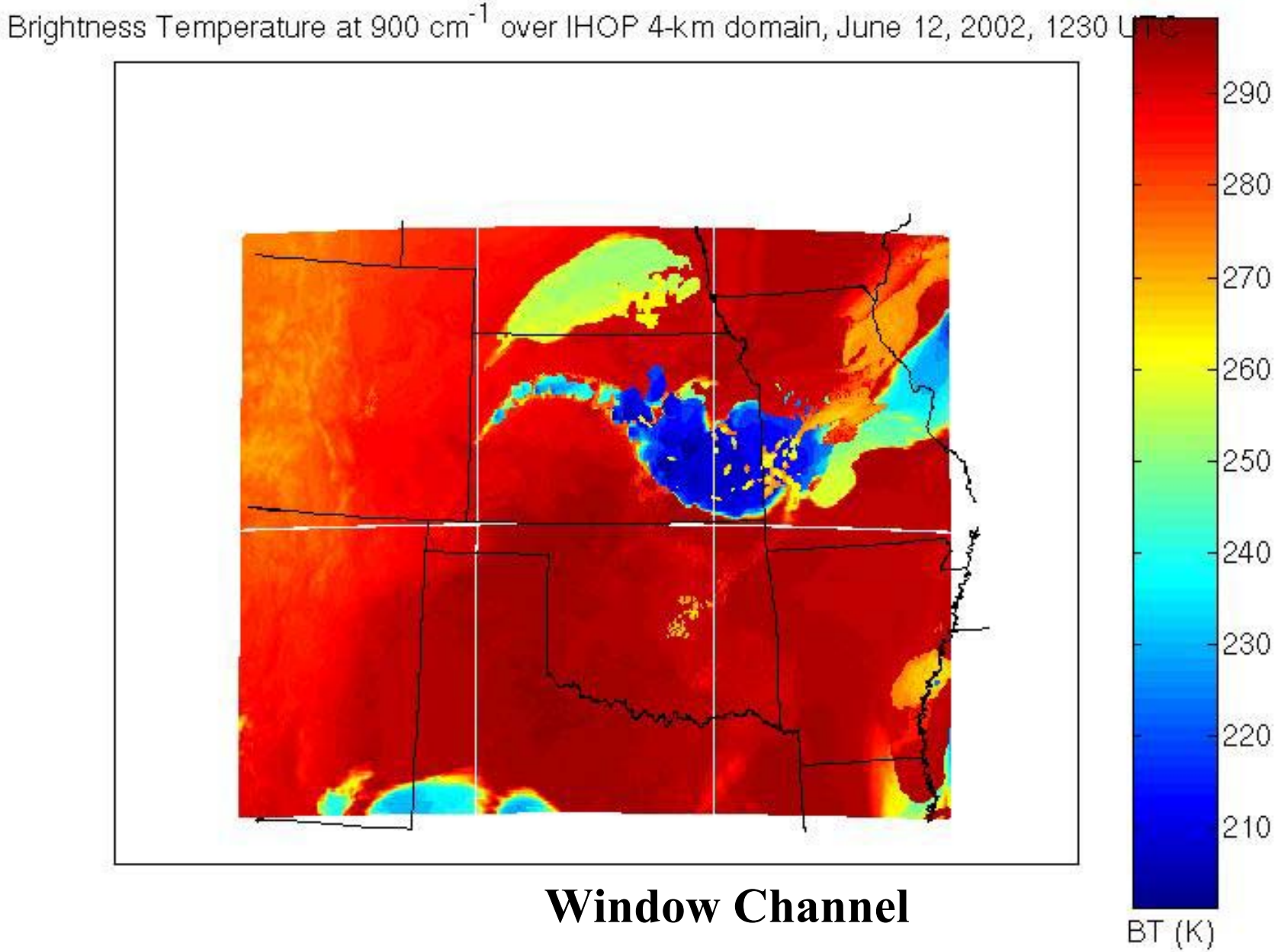
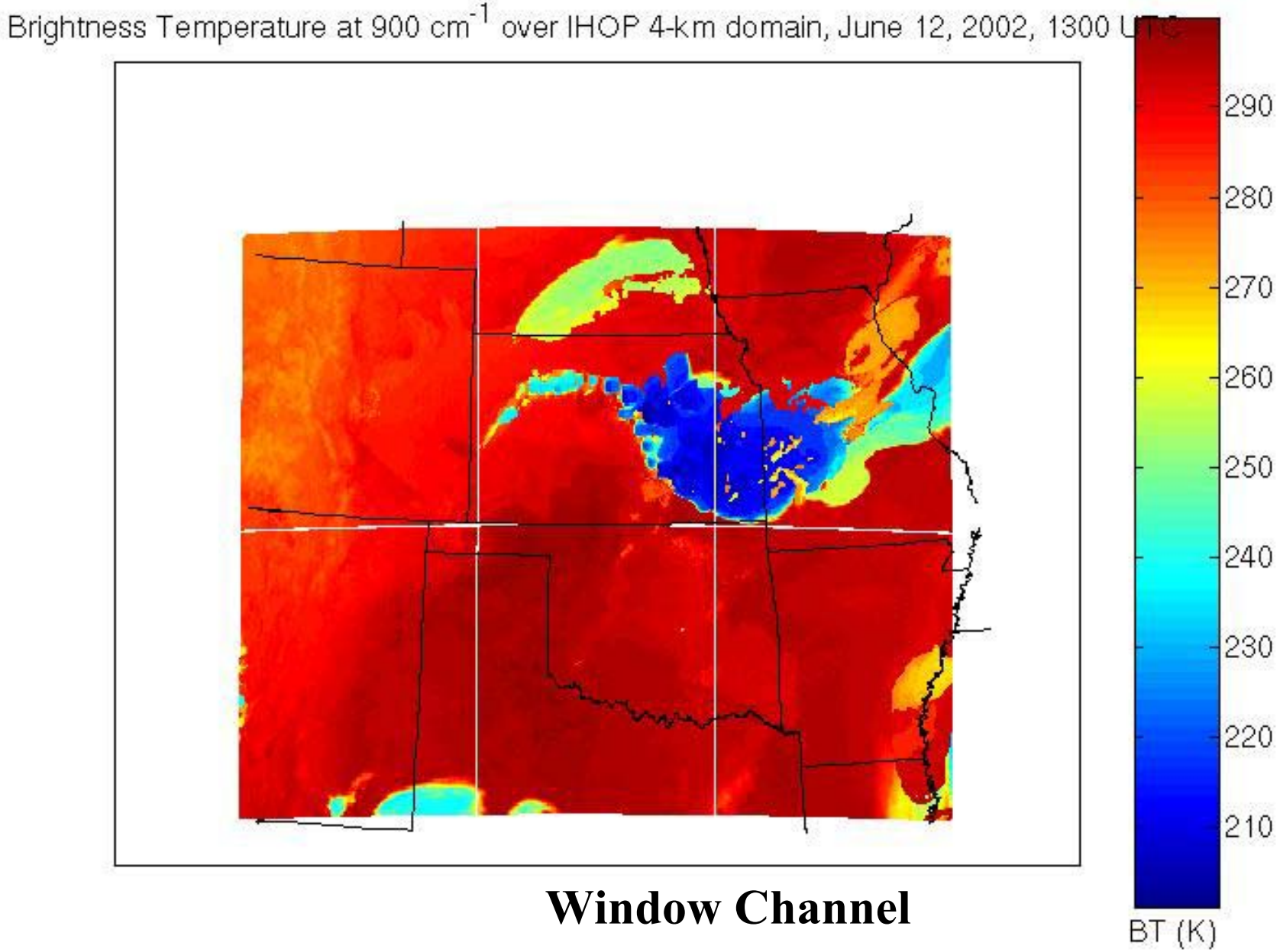
BT (K)

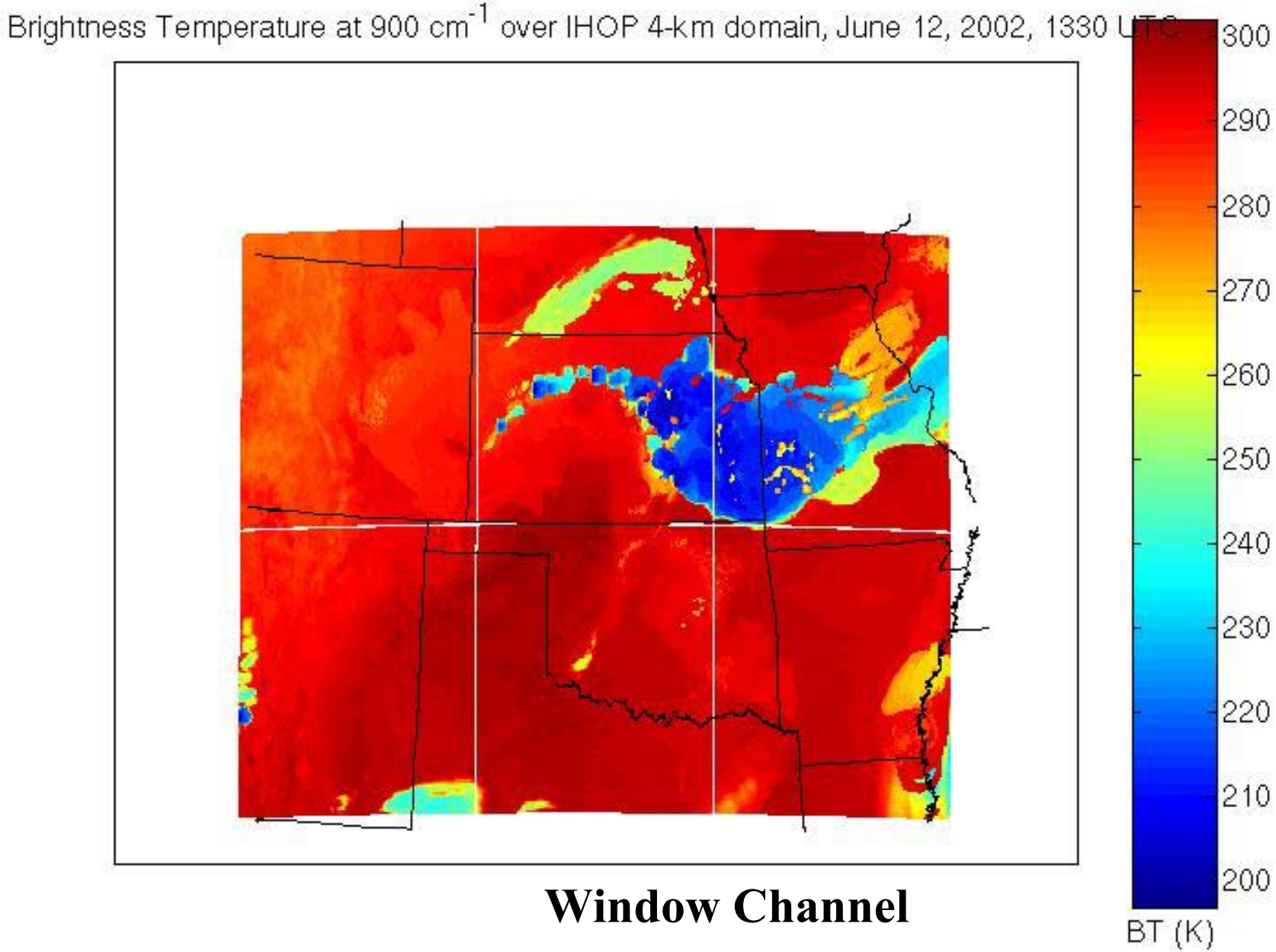
**$CO_2$ Channel**



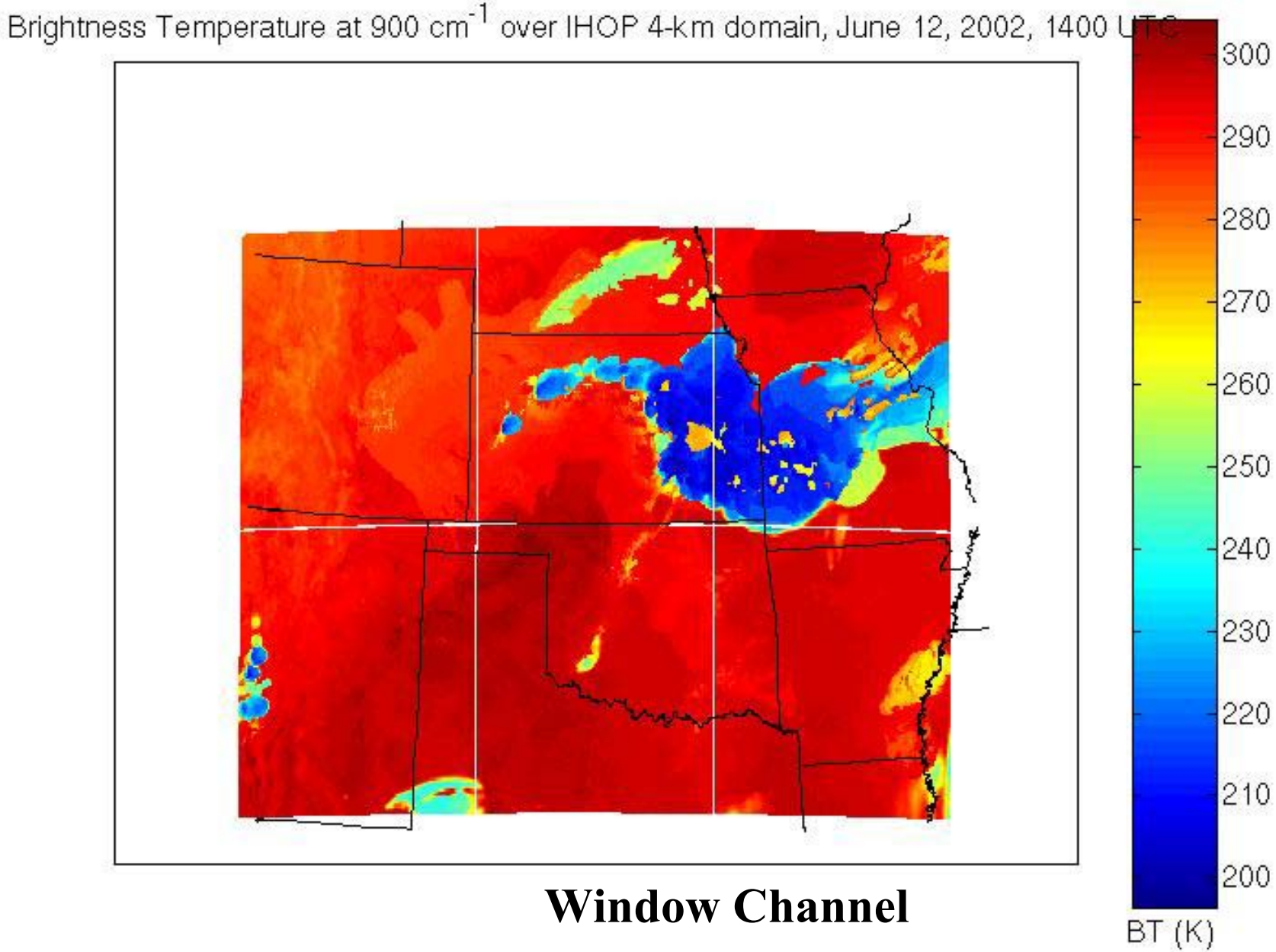

**Window Channel**



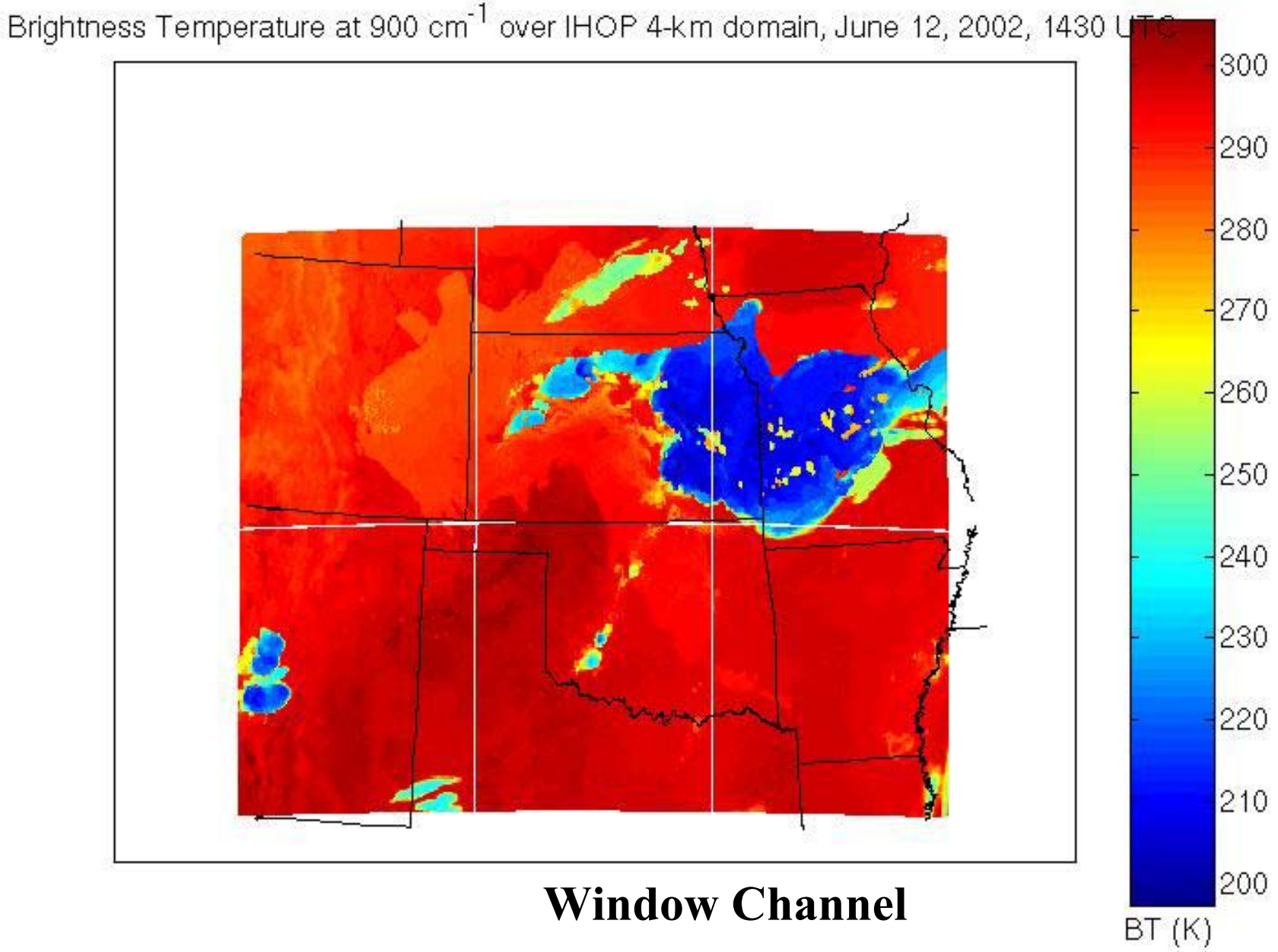

**Window Channel**




**Window Channel**

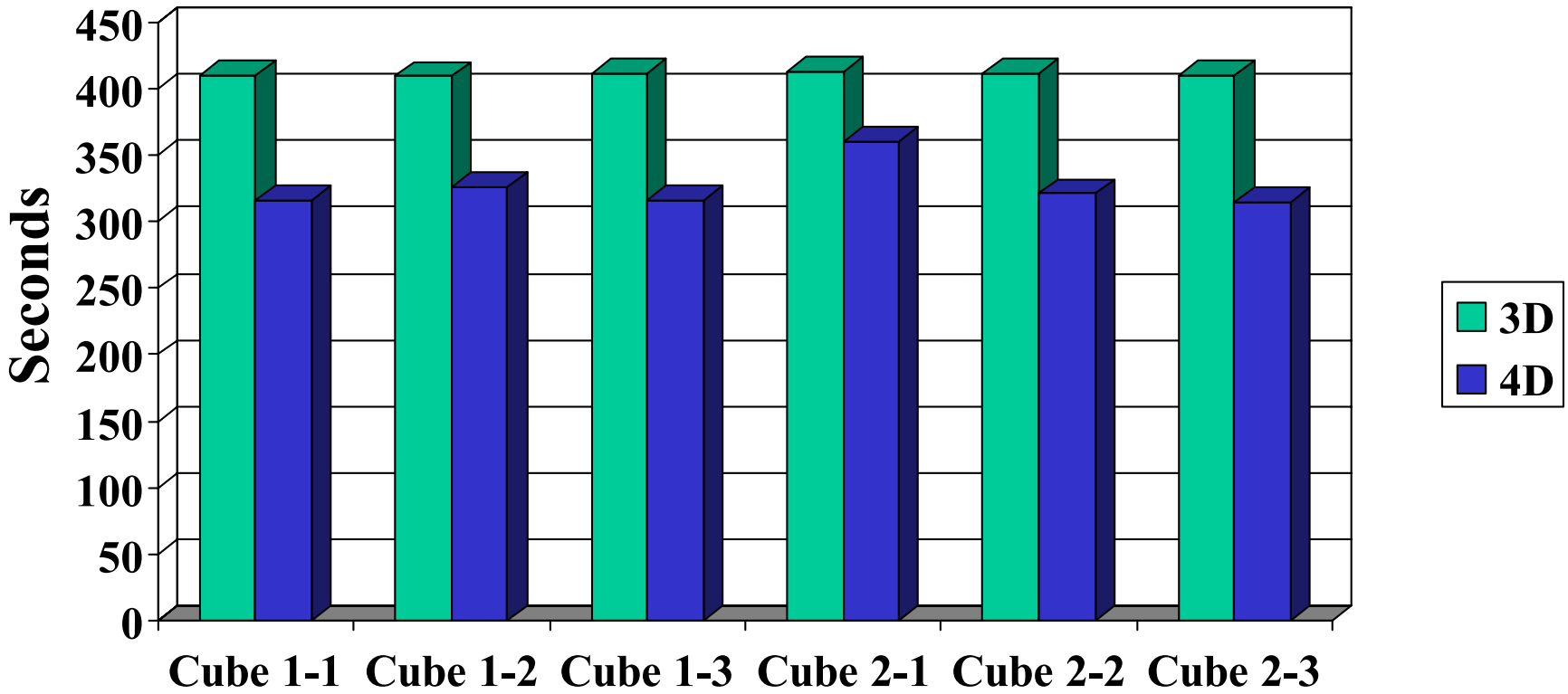



**Window Channel**

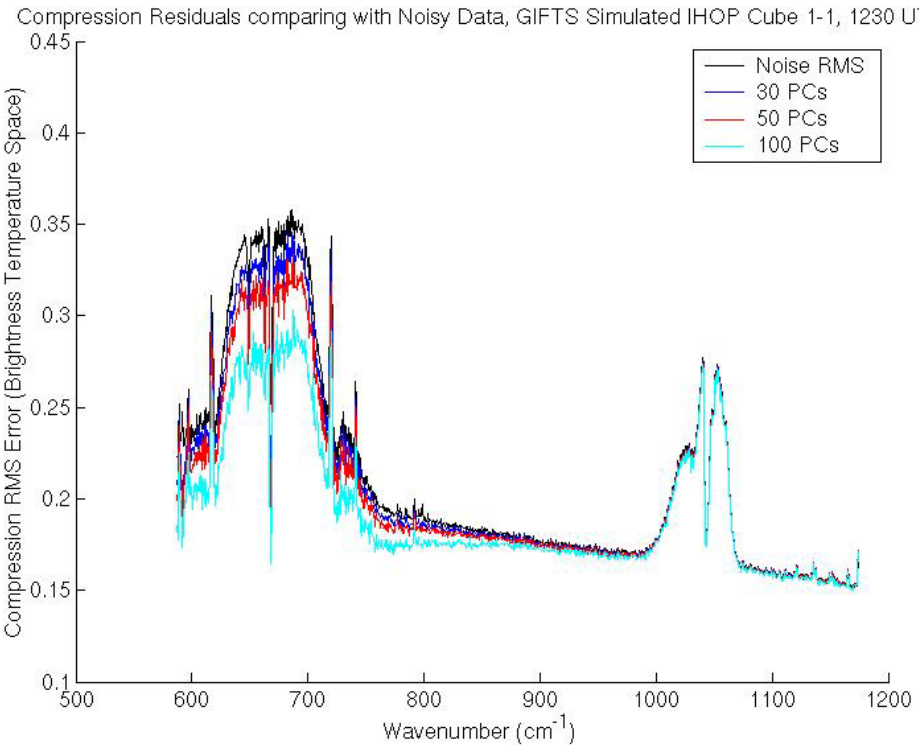


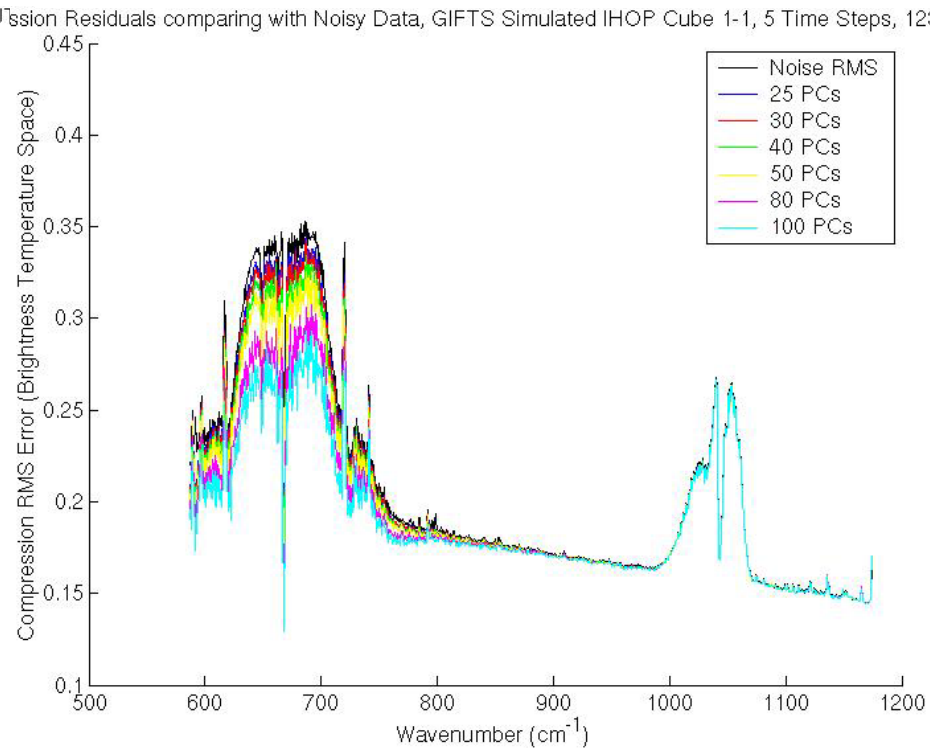

**Window Channel**

# DPCA Timing on 3D Vs. 4D Simulated Longwave Data Cubes



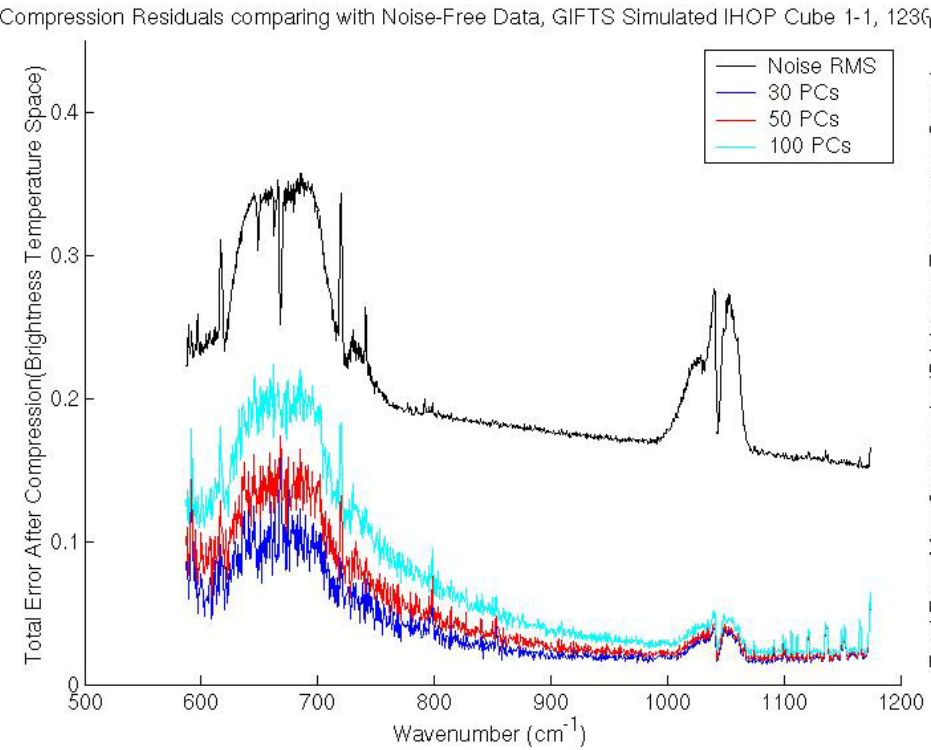
# DPCC Performance of 3D Vs. 4D Simulated Longwave Data Cubes

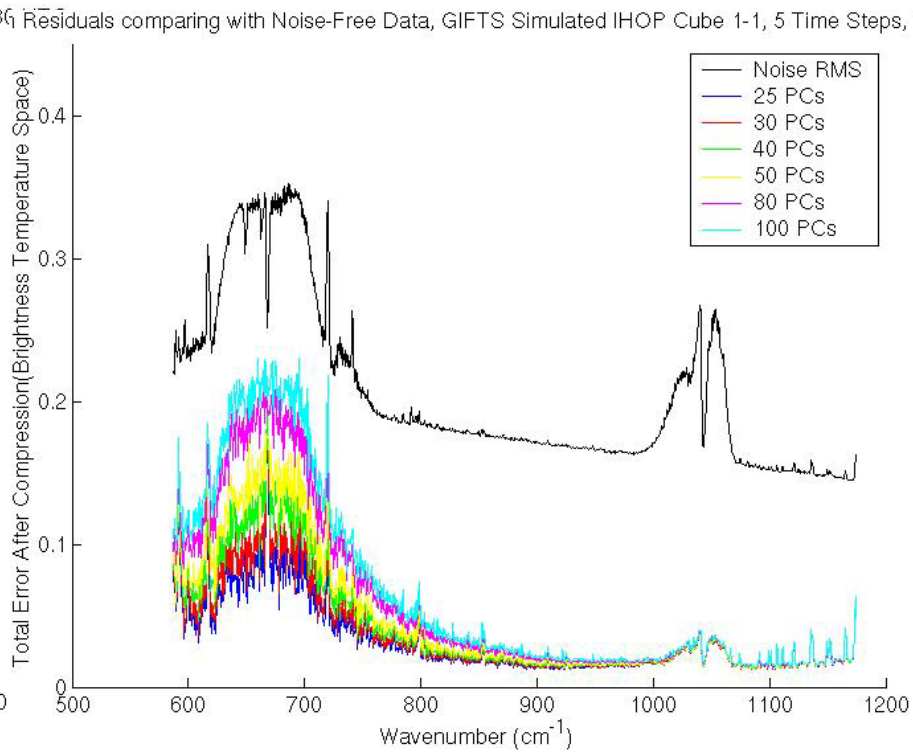



With Noisy Data

# DPCC Performance of 3D Vs. 4D Simulated Longwave Data Cubes



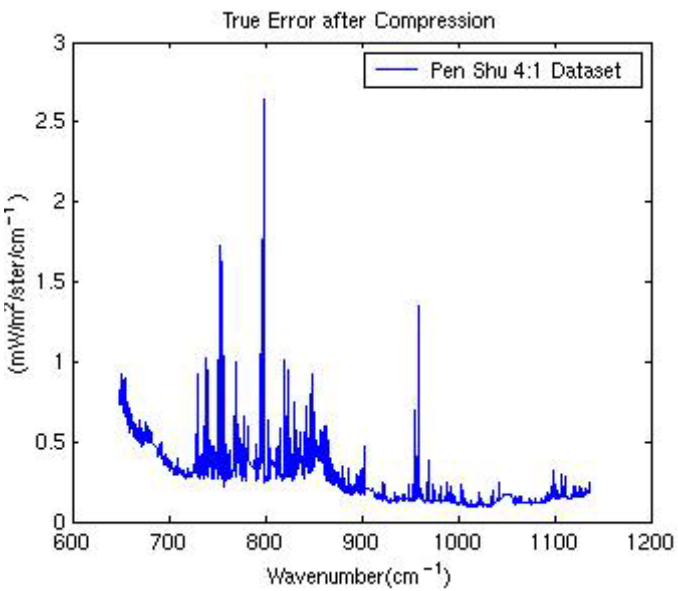



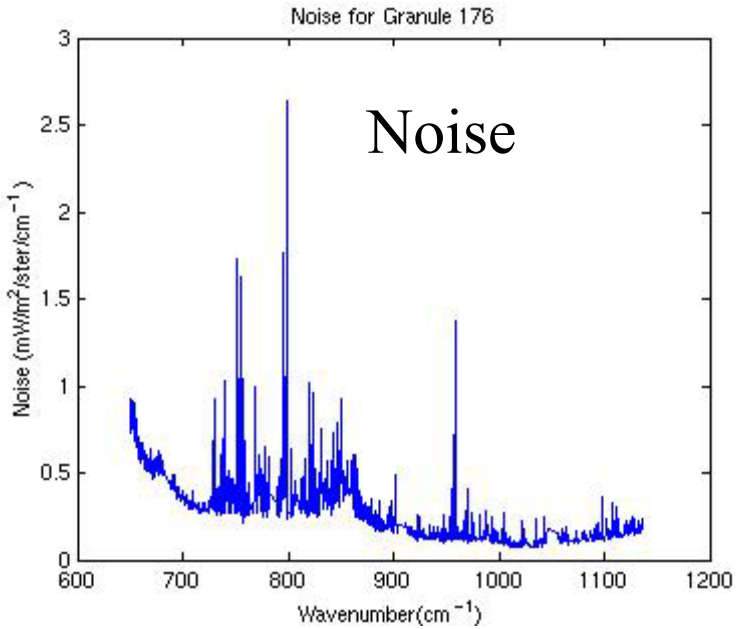

With Noise Free Data

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Spectral Residual

## GSFC 4:1 Lossy

Compression Residual



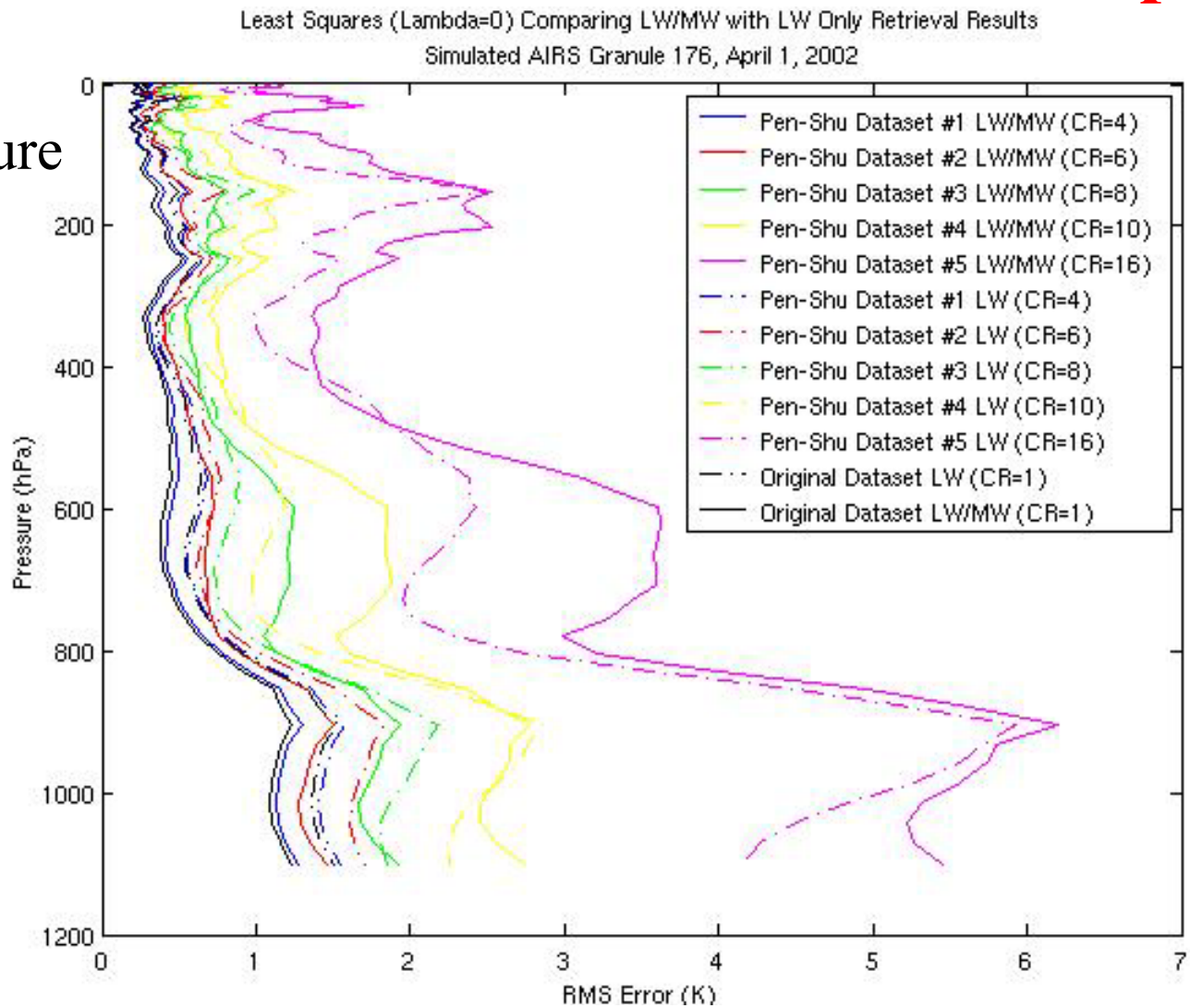




CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Retrieval Impacts

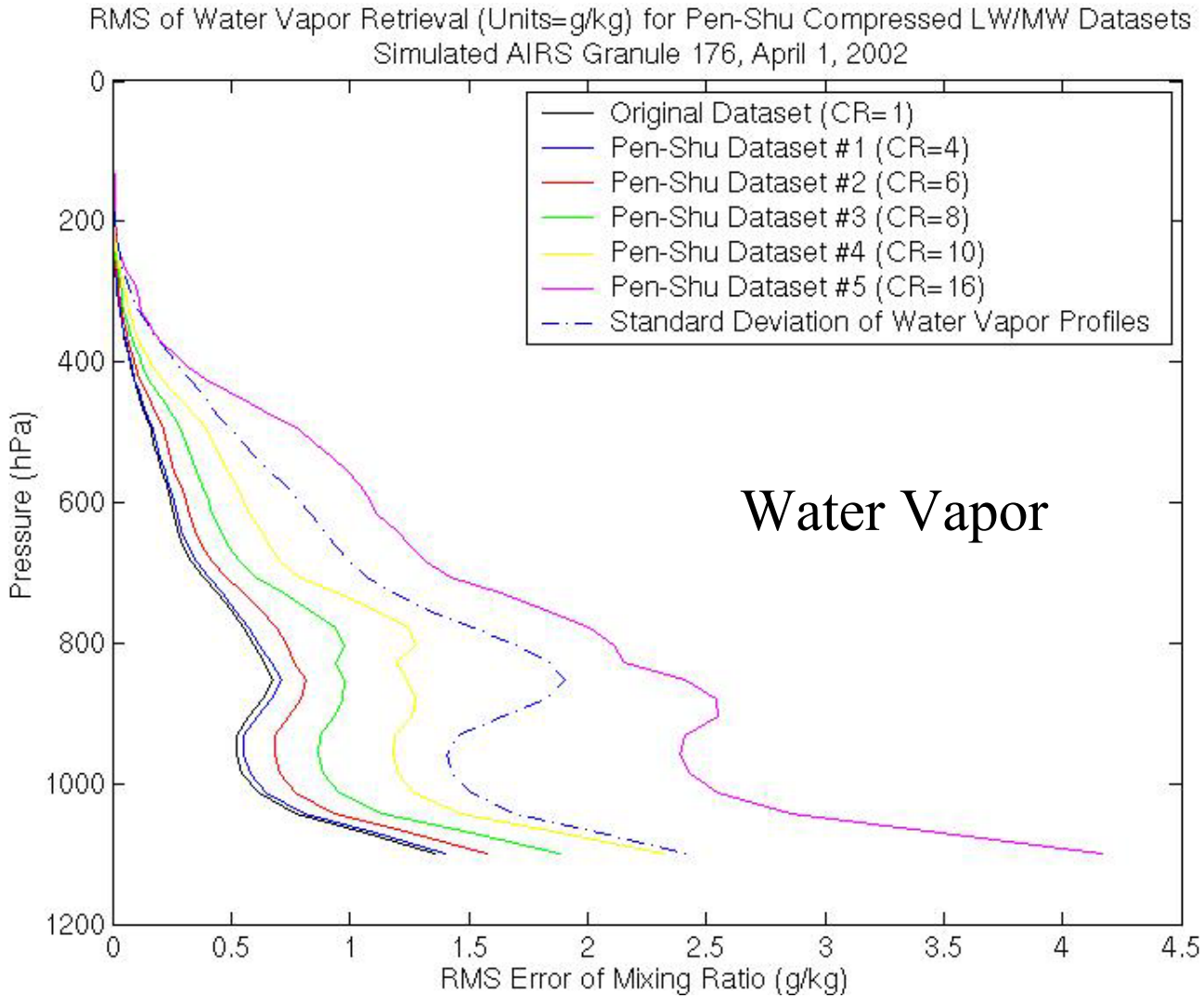
Temperature




CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Retrieval Impacts

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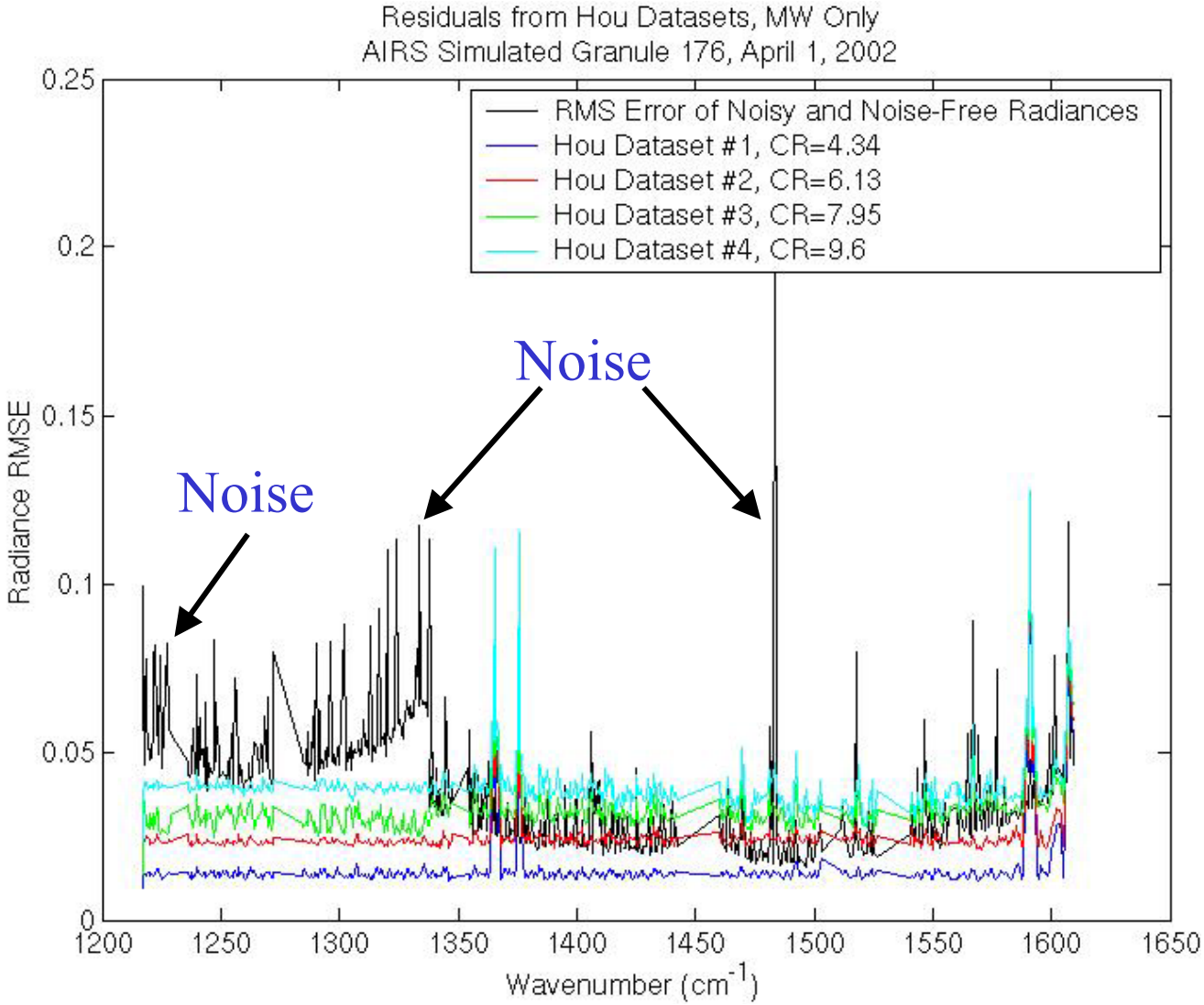
NOAA

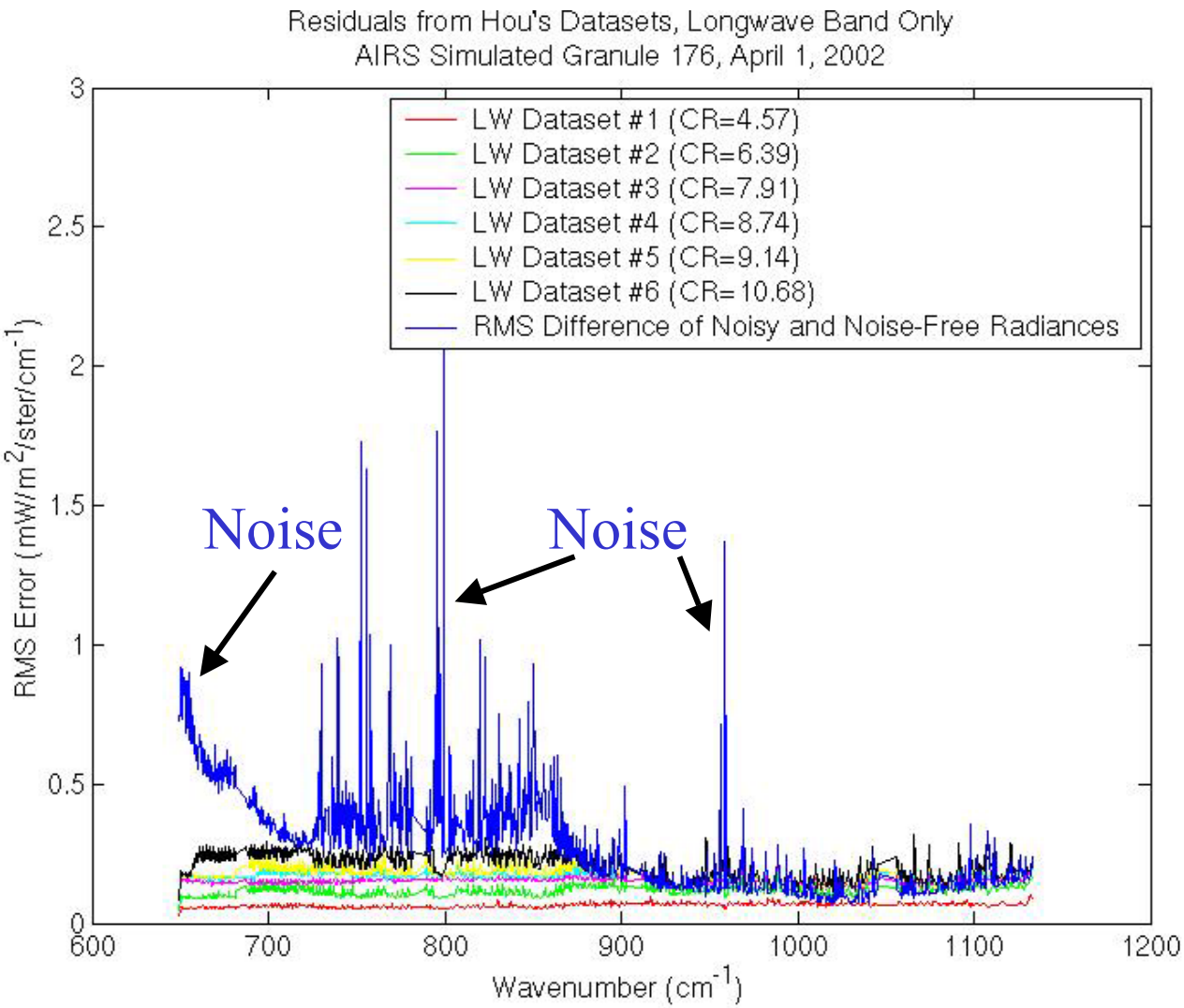
# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Spectral Residual




CIMSS

NOAA

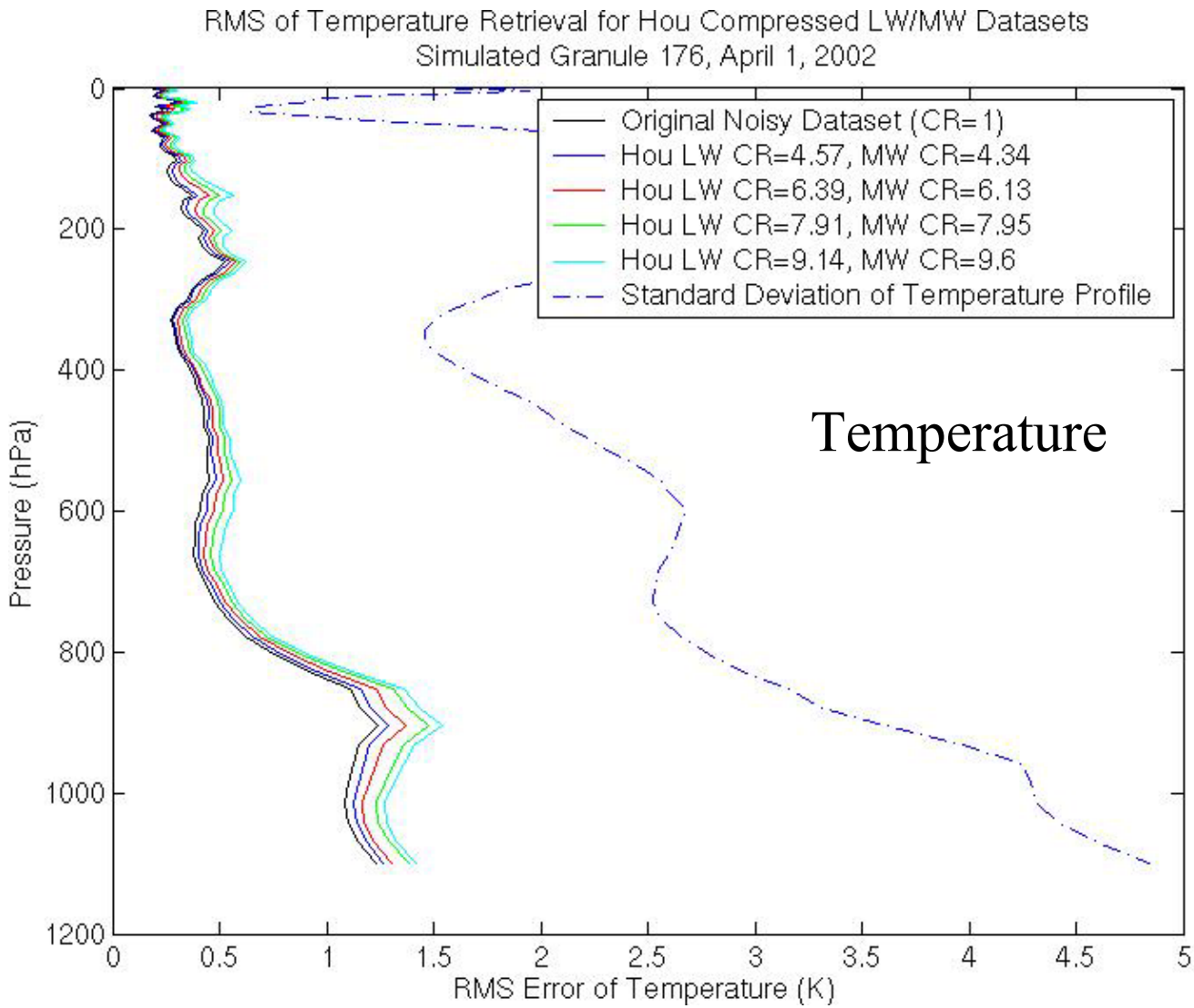
# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Spectral Residual




CIMSS

NOAA

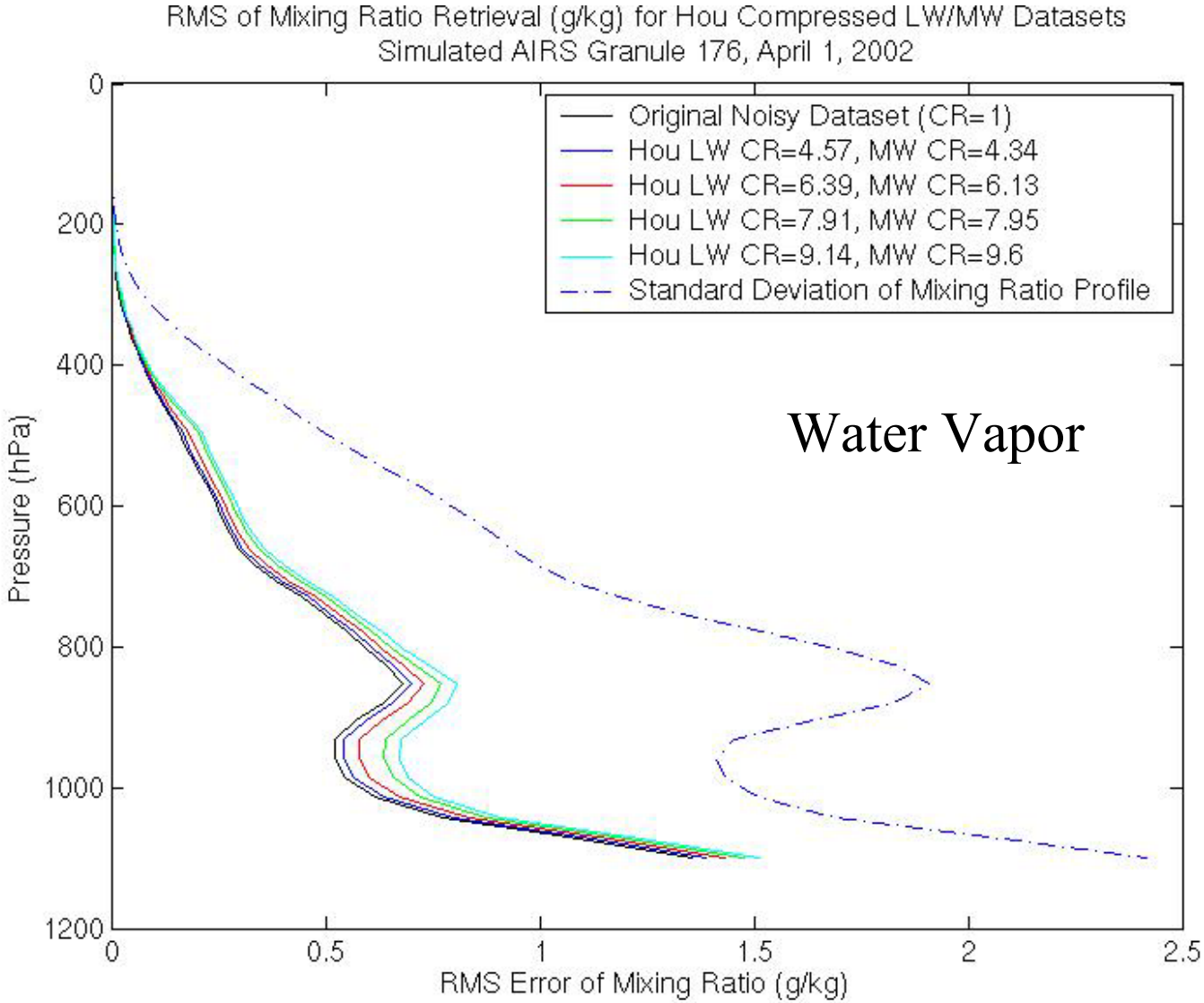
# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Retrieval Impacts




CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Retrieval Impacts

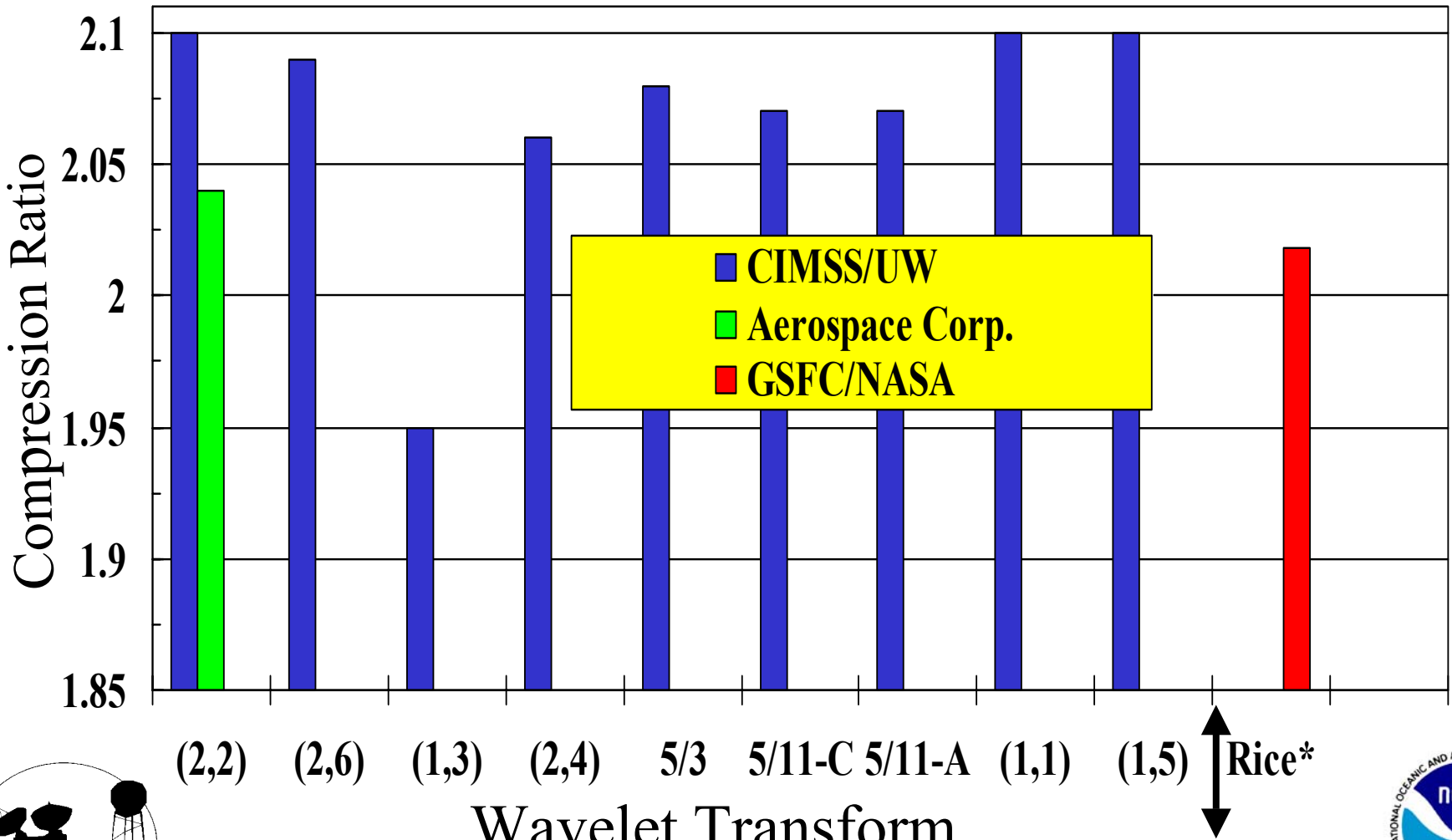



CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Comparison

## For Noisy Data

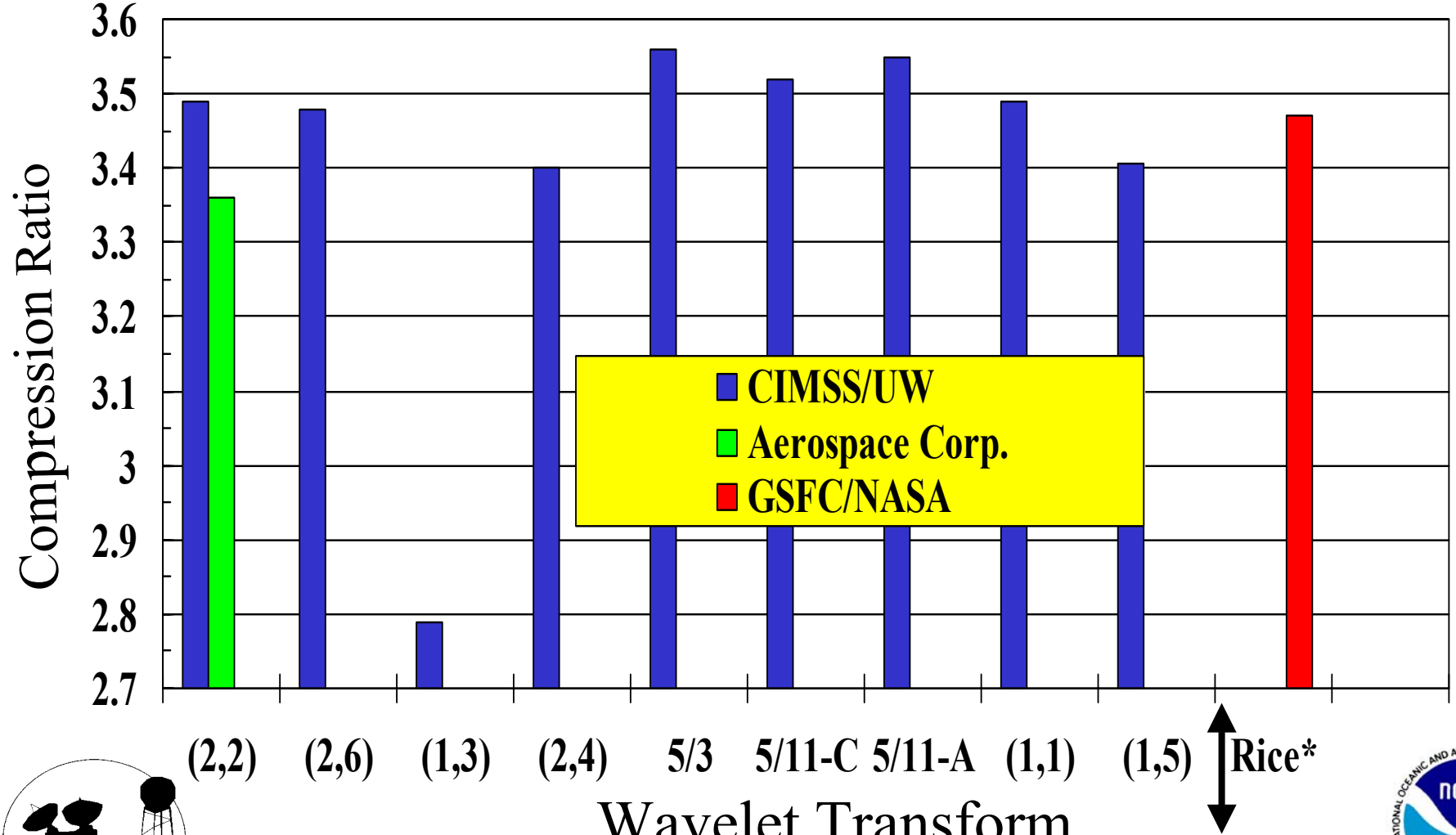



CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION Comparison

## For Noise Free Data




CIMSS

NOAA

# CURRENT HIGH-SPECTRAL RESOLUTION DATA COMPRESSION STUDY STATUS

**CIMSS** – 3D Wavelet Lossless (~2); 3D Wavelet Lossy (>4)

DPC-3D/4D Lossy (>4; tunable) (On-ground only)

**NESDIS** – 3D IPC Lossy (>4; tunable) (On-ground only)

**Aerospace** - Wavelet Lossless (~2)

Wavelet Lossy (>4; tunable)

**GSFC** - Rice Lossless (~2)

Bit plane encoding Lossy (>4; tunable)

CIMSS

NOAA